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June 2021

MINIMUM THRUST FUNCTION TARGETED ENERGY DESTRUCTION BY THE BRAKE

Axel Unger
Bertrandt Ingenieurbüro GmbH

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Recommended Citation

Unger, Axel, "MINIMUM THRUST FUNCTION TARGETED ENERGY DESTRUCTION BY THE BRAKE",
Technical Disclosure Commons, (June 23, 2021)
https://www.tdcommons.org/dpubs_series/4408



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MINIMUM THRUST FUNCTION: TARGETED ENERGY DESTRUCTION BY THE BRAKE

Technical task:

During long trips in the mountains, the brake may have to endure high temperatures for a long time. In addition to the disc and pads, this permanent temperature input also leads to a significant temperature increase in the brake fluid. If the fluid temperature exceeds the boiling point temperature of the brake fluid, the brake fluid suddenly changes to a gaseous state when the brake is released. When the brake is applied again, this gas is compressed without building up any significant pressure in the system and thus braking torque. The vehicle does not decelerate. This occurs particularly in vehicles with brake fluid that is not changed regularly.

In the event of sudden braking, the driver is taken by surprise by the reduction in braking effect or total failure. This costs valuable seconds or makes deceleration of the vehicle impossible. Ultimately, this can lead to serious accidents.

From patent DE 102010020495 B4 we know a message that prompts the driver to relieve the brake by engaging driving step D or a suitable gear.

From the patent DE 10 2016 004 804 B4 we know a possibility to achieve a relief of the brake by recuperation during a long downhill drive with a full battery by switching on current consumers for energy dissipation.

Disadvantage:

Activating energy consumers to relieve the brakes requires a relatively high degree of networking and thus a high development effort even for "basically uninvolved" vehicle components.

In some electric car concepts, it is also difficult to find consumers that have significant power dissipation potential (approx. 10kW power to be dissipated!).

Solution:

Battery discharge is achieved by simultaneous driving and braking. After the battery has been sufficiently discharged, it is then possible to switch to recuperation mode.

The vehicle is braked at the same rate as the engine is driven. The driver notices almost nothing.

Not all wheels are braked, but only one brake circuit. In the case of a black/white split, the rear-axle brake circuit is used primarily; otherwise, only part of the available brake circuits (usually one of two) is used.

Depending on the expected length of the hill, this type of energy dissipation is interrupted when the free battery capacity has become available for sufficient relief through recuperation or the braked brake circuit is in danger of failing due to thermal overload.

It is also conceivable to continue this procedure permanently in support of recuperation (at least for motors at the VA and HA, this can be implemented) or to alternate between braking - recuperation - braking - recuperation, etc., for as long as the downhill drive lasts. It can also be advantageous to exchange the braked brake circuit again and again.

Advantages:

Using the brake to dissipate energy avoids having to include other components in the subject matter in addition to the brake and drive. The brake is basically designed for high energy conversion and can therefore provide sufficient relief.

The brake can be given sufficient recovery time by cyclic operation (a permanently high temperature without the possibility of cooling down is particularly damaging). This effect is further supported by alternating the brake circuits.

By limiting the number of brake circuits to one (especially in the case of black/white splitting), a maximum of one brake circuit can fail and at least half the braking effect is retained. With modern braking systems, this is sufficient to brake the vehicle to a standstill in such a situation.

Possible application:

The vehicle is fully loaded at the top of the hill. It starts the downhill drive. After a short time, a corresponding gradient is detected for a certain time (e.g. >8%) and the downhill procedure is started. If necessary, this can also be supported by GPS or predictive map reading to detect a long hill. (I think the downhill detection is sufficiently patented).

The vehicle recognizes that the battery capacity required for recuperation is insufficient for the upcoming descent and begins to dissipate energy via the drive and brake. Depending on the implementation, this can continue up to a certain amount of energy or up to a limit temperature (brake disc or brake fluid) in the brake circuit used or for a certain time. Then the system switches to recuperation and the battery is replenished. When the battery then reaches a certain filling level (e.g. 95%), energy can again be dissipated via the drive and brake. The cycle continues until an end of hill descent is detected.

It is advantageous to carry out the brake cycles alternately with the brake circuits, if necessary, e.g. brake circuit1 recu - brake circuit2 - recu.

It is also advantageous if the recuperation itself is carried out "inefficiently" (efficiency as low as possible).

The sketch below shows on the one hand the change of drive+brakes/recu/drive+brakes in brown, and the temperature behavior of brake or brake disk in red.

